

What is claimed is:

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1. A method of compressing a grinding sludge containing an oil-based coolant to make a compressed solid material, which sludge is a grinding sludge resulting from a hardened steel material used as a material for bearings, which method comprises the steps of:

filtering the grinding sludge to provide a concentrated sludge; and

compressing the concentrated sludge by squeezing to thereby provide the compressed solid material.

2. The method of compressing the grinding sludge as claimed in Claim 1, wherein the grinding sludge before being filtered is a fluid medium containing the coolant in a quantity equal to or greater than 90 wt%.

3. The method of compressing the grinding sludge as claimed in Claim 1, wherein the compressed solid material formed by the compressing step contains the coolant in a quantity within the range of 5 to 10 wt%.

4. The method of compressing the grinding sludge as claimed in Claim 1, wherein during the filtering step, the grinding sludge is guided towards a filtering belt and is filtered under pressure by utilization of compressed air.

5. The method of compressing the grinding sludge as claimed in Claim 1, wherein where a plurality of kinds of the coolants are used in a grinding line, the filtering step and the compressing steps are performed for each kind of the coolants in a paralleling fashion.

6. The method of compressing the grinding sludge as claimed in Claim 1, wherein the steel material used as a material for the bearings is component parts of a rolling bearing.

7. An apparatus for making a compressed solid material by compressing a grinding sludge containing an oil-based coolant, which sludge is a grinding sludge resulting from a hardened steel material used as a material for bearings, which apparatus comprises:

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a filtering means for filtering the grinding sludge to provide a concentrated sludge; and

a compressing means for compressing the concentrated sludge by squeezing to thereby provide the compressed solid material.

8. An apparatus for making a compressed solid material by compressing a grinding sludge containing a coolant, which sludge is produced in a grinding line for grinding hardened component parts, by filtering the grinding sludge to provide a concentrated sludge which is subsequently compressed by squeezing to provide a compressed solid material, said apparatus comprising:

a primary press unit for accommodating a predetermined quantity of the concentrated sludge and pre-compressing the concentrated sludge that has been accommodated; and

a secondary press unit for compressing the pre-compressed sludge under a predetermined pressure to thereby provide the compressed solid material.

9. The apparatus as claimed in Claim 8, wherein the primary press unit is a vertical press having a primary compressing chamber in which the concentrated sludge is pre-compressed in a downward direction and includes a shutter defined at a lower end thereof for discharge of the pre-compressed sludge and wherein the secondary press unit is a transverse press including a secondary compressing chamber having a portion positioned immediately below the shutter for receiving the pre-compressed sludge by way of the shutter.

10. The apparatus as claimed in Claim 8, further comprising a sludge supply unit positioned above the primary press unit for supplying the concentrated sludge into the primary compressing chamber, said sludge supply unit being a vertical type sludge supply unit including a hopper through which the concentrated sludge is allowed to fall by gravity into the primary compressing chamber through a sludge receiving port of the primary press unit positioned below the hopper.

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11. The apparatus as claimed in Claim 8, further comprising a heating means for heating and maintaining the primary press unit to and at a predetermined temperature range.

12. The apparatus as claimed in Claim 8, further comprising a press control means for controlling a pressing work used for squeezing in the secondary press unit to a predetermined pressure and a predetermined compressing speed.

13. The apparatus as claimed in Claim 8, wherein the secondary press unit has a discharge port defined therein for discharge of the compressed solid material, and further comprising a transport path following the discharge port, said transport path being divided into two paths, and a sorting means for selectively switching the compressed solid material, discharged from the discharge port, onto one of the two paths.

14. The apparatus as claimed in Claim 13, further comprising a pressure sensor provided in the secondary press unit and a sorting control means for controlling a switching operation of the sorting means by comparing a pressure detected by the pressure sensor with a threshold value.

✓ 15. The apparatus as claimed in Claim 8, wherein the coolant contained in the grinding sludge is an oil-based coolant.

✓ 16. The apparatus as claimed in Claim 8, wherein the hardened component parts are those of a rolling bearing.

17. An apparatus for making a compressed solid material by compressing a grinding sludge containing a coolant, which sludge is produced in a grinding line for grinding hardened component parts, by filtering the grinding sludge to provide a concentrated sludge which is subsequently compressed by squeezing to provide a compressed solid material, said apparatus comprising:

heating
unit

a primary press unit for accommodating a predetermined quantity of the concentrated sludge and pre-compressing the concentrated sludge that has been accommodated; and

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a heating means for heating and maintaining the concentrated sludge within the primary press unit to and at a predetermined temperature range.

18. The apparatus as claimed in Claim 17, wherein the heating means comprises a heater disposed in the primary press unit.

19. The apparatus as claimed in Claim 17, wherein the heating means comprises a hot air blower for blowing a hot air to the primary press unit.

20. The apparatus as claimed in Claim 17, wherein the predetermined temperature range to and at which the concentrated sludge within the primary press unit is heated and maintained is from 20 to 60 °C.

21. The apparatus as claimed in Claim 17, wherein the coolant is oil-based and of a paraffin type.

22. The apparatus as claimed in Claim 17, wherein the primary press unit is a vertical press having a primary compressing chamber within which the sludge is downwardly compressed.

23. The apparatus as claimed in Claim 17, wherein the hardened component parts are ferrous component parts of a rolling bearing.

24. An apparatus making a compressed solid material by for compressing a grinding sludge containing a coolant, which sludge is produced in a grinding line for grinding hardened component parts, by filtering the grinding sludge to provide a concentrated sludge which is subsequently compressed by squeezing to provide a compressed solid material, said apparatus comprising:

a press unit having a compressing chamber defined therein for compressing the concentrated sludge within the compressing chamber to thereby provide the compressed solid material; and

a press control means for controlling a pressure used for squeezing to a predetermined pressure and a predetermined compressing speed.

25. The apparatus as claimed in Claim 24, wherein the press control means is operable to retain the pressure for a predetermined time when the pressure applied attains a target pressure.

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26. The apparatus as claimed in Claim 25, wherein the predetermined time during which the pressure is retained is equal to or greater than 10 seconds.

27. The apparatus as claimed in Claim 24, wherein the press control means repeatedly performs an operation to retain the predetermined pressure for the predetermined length of time a number of times during a period in which the pressure used during squeezing is progressively increased.

28. The apparatus as claimed in Claim 27, wherein the predetermined time over which the pressure is retained during the period in which the pressure is progressively increased is within the range of 2 to 3 seconds.

29. The apparatus as claimed in Claim 24, wherein the press control means is operable to slowly reduce the compressing speed.

30. The apparatus as claimed in Claim 24, wherein the press control means applies the pressure for squeezing which is equal to or lower than 400 MPa.

31. The apparatus as claimed in Claim 24, wherein the press unit drives a pressing member by means of a ball screw mechanism driven by an electric motor.

32. The apparatus as claimed in Claim 24, wherein the hardened component parts are ferrous component parts of a rolling bearing.

33. The apparatus as claimed in Claim 24, wherein the coolant is an oil-based coolant.

34. A compressed solid material prepared by compressing a grinding sludge containing a coolant, which sludge is produced in a grinding line for grinding hardened component parts, by squeezing, said compressed solid material being of a hollow cylindrical shape having a hollow defined therein.

35. The compressed solid material as claimed in Claim 34, wherein the ratio of an inner diameter D2 of the cylindrical hollow relative to an outer diameter D1 of the compressed solid material is $D2/D1 = 0.40$ to 0.60 .

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37. The compressed solid material as claimed in Claim 34, wherein the coolant in the compressed solid material is an oil-based coolant, the amount of said oil-based coolant being within the range of 5 to 10 wt%.

38. The compressed solid material as claimed in Claim 34, wherein the hardened component parts are ferrous component parts of a rolling bearing.

39. A grinding sludge recycling method for recycling a compressed solid material of the grinding sludge as a material for steel production, said recycling system comprising filtering the grinding sludge, produced in a grinding line for grinding hardened component parts, to provide a concentrated sludge which is subsequently compressed by squeezing to thereby provide the compressed solid material while a coolant separated from the grinding sludge during filtering and compressing processes is returned to the grinding line.

40. The grinding sludge recycling method as claimed in Claim 39, wherein the hardened component parts are steel material used for bearings.

41. The grinding sludge recycling method as claimed in Claim 40, wherein where a plurality of kinds of coolants are used in the grinding line, a plurality of processing lines are distributed depending on the kinds of the coolants used, each of said processing lines including means for performing the filtration, means for compressing by squeezing, a transport path for transporting the grinding sludge from the grinding line to the filtering means, and coolant recovery passages for returning the associated coolant from the filtering means and the compressing means back to the grinding line.

42. The grinding sludge recycling system for recycling a grinding sludge produced in a grinding line for grinding hardened component parts, said recycling system comprising:

a transport means for transporting the grinding sludge;

a filtering means for filtering the grinding sludge so transported to thereby provide a concentrated sludge;

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a compressing means for compressing by squeezing the concentrated sludge to thereby provide a compressed solid material; and

coolant recovery passages for returning a coolant separated from the grinding sludge during filtering and compressing processes back to the grinding line.

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